PolyGard® ADTD3-1192

Infrared Dinitrogen Monoxide (Laughing Gas) Transmitter
Serial No. AT03-00X

User Manual

October, 2011

GAADTD31192_E_1011

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

Infrared Dinitrogen Monoxide (Laughing Gas) Transmitter

1 Intended Use

The PolyGard® N_2O analog/digital transmitter ADT-D3-1192 with two-beam infrared sensor, digital processing of the measuring values and temperature compensation is used for the monitoring the ambient air and detecting dinitrogen monoxide (laughing gas) concentrations.

The intended sites are all areas being directly connected to the public low voltage supply, e.g. residential, commercial and industrial ranges as well as small enterprises (according to EN50 082).

The PolyGard® N_2O analog/digital transmitter must not be used in potentially explosive atmospheres. The transmitter must only be employed in areas within the environmental conditions as specified in the Technical Data.

2 Functional Description

2.1 Control Mode

In addition to the analog output the transmitter is equipped with a serial interface RS-485 for the connection to the PolyGard® DGC-05 system.

Analog mode:

The analog output can be selected as current signal with (0)4-20 mA or as voltage signal (0)2-10 V. In the 4-20 mA mode and without any supplementary options, the ADTD3 only works in the 3-wire technique.

DGC-05_Bus mode:

The transmitter can be connected to the PolyGard® DGC-05 system via the RS-485 interface. In this mode there is an analog input for the connection of an additional 4-20 mA transmitter. The two measuring values are transmitted via the RS-485 interface to the gas controller.

The cable topology for the RS-485 bus can be taken from the “Guidelines for wiring and commissioning of the DGC-05 hardware”.

The two control modes are available in parallel.

2.2 Sensor

The integrated sensor is based on the principle of the infrared absorption of gases and accomplishes highest requirements concerning accuracy, reliability and economy. The sensor technology uses the individual absorption spectrum of the dinitrogen monoxide gas (laughing gas) and appoints its exact concentration through its accurate, quantitative analysis. The infrared principle nearly eliminates the cross-sensitivity to other gases.

An integrated evaluation electronic system reliably compensates all drift and temperature influences and therefore a genuine measurement result is guaranteed.

The sensor is factory-calibrated for a period of 4 years.

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

3 Installation

Note: Avoid any force (e.g. by thumb) on the sensor element during operation or installation. Electronics can be destroyed by static electricity. Therefore, do not touch the equipment without a wrist strap connected to ground or without standing on a conductive floor (acc. to DIN EN100015).

3.1 Mounting Instructions

When choosing the mounting site please pay attention to the following:

- The specific weight of dinitrogen monoxide (laughing gas) N_2O is higher than that of air (factor 1.529). **Recommended mounting height is 0.6 m (2 feet) to 0.8 m (2.5 feet) above floor.**
- Choose mounting location of the sensor according to the local regulations.
- Consider the ventilation conditions! Do not mount the transmitter in the centre of the airflow (air passages, suction holes).
- Mount the transmitter at a location with minimum vibration and minimum variation in temperature (avoid direct sunlight).
- Avoid locations where water, oil etc. may influence proper operation and where mechanical damage might be possible.
- Provide adequate space around the sensor for maintenance and calibration work.

Duct mounting

- Mount only in a straight section of duct with minimum air vortex. Keep a minimum distance of 1 m (3.5 feet) from any curve or obstacle.
- Mount only in a duct system with a maximum air velocity of 10 m/s (2000 ft/min) or less.
- Mounting must be performed so that the probe openings are in line with the airflow.

3.2 Installation

- Open the cover. (The cover incl. the sensor is connected by a safety rope with the lower part of the housing.)
- Fix the housing to the wall through the holes at the corners using the enclosed screws/ wall anchors (sensor down).
- Replace the cover.

4 Electrical Connection

Consider static electricity! See 3. Mounting

- Installation of the electrical wiring should only be executed by a trained specialist according to the connection diagram, without any power applied to conductors and according to the corresponding regulations!
- Avoid any influence of external interference by using shielded cables for the signal line, but do not connect the shield.
- Recommended cable for analog mode: J-Y(St)Y 2x2x0.8 LG (20 AWG), max. loop resistance 73 Ω/km (20.8 Ω/1000 ft).
- Serial Interface Mode:

  Required cable for RS-485 mode: J-Y(St)Y 2x2x0.8 LG (20 AWG), max. loop resistance 73 Ω/km (20.8 Ω/1000 ft)

  When selecting and installing the cables you have to comply with the regulations concerning the RS 485 bus installation. The installations have to be executed in line topology. Cable length and type have to be considered as well.
- It is important to ensure that the wire shields or any bare wires do not short the mounted PCB.

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

4.1 Wiring Connection

- Open the cover. Unplug basic PCB carefully from terminal blocks X4 and X5. Pay attention to the cable to the sensor.
- Insert the cable and connect cable leads to terminal blocks. See fig. 1 and 2.
- Replug the PCB in the terminal blocks X4, X5 with care. Replace the cover.

Note: The connection of the power supply at the output signal (X4 pin 4) can destroy the transmitter.

5 Commissioning

Consider commissioning instructions at any exchange of the sensor element as well.

Only trained technicians should perform the following:

The filter at the gas inlet is part of the IP65 protection and must not be removed.

- Check mounting location.
- Select output signal form: Current or voltage, and starting point 0 or 20%. See fig.3 and 4.
- Check power voltage.
- Check PCB SM03 for correct mounting at X4 and X5.
- Addressing of the transmitter in the DGC-05_Bus mode.
- The transmitter is already factory-calibrated for 4 years. Therefore calibration is not required at commissioning.

Required instruments for calibration of the transmitter:

- Test gas bottle with nitrogen for zero-point calibration.
- Test gas bottle with N_2O in the range of 30 – 70 % of the measuring range. Rest is synthetic air.
- Gas pressure regulator with flow meter to control the gas flow to 1500 ml/min.
- Calibration adapter Calibration-set 4. See fig. 5.
- Digital voltmeter with range 0 – 300mV, accuracy 1%
- A small screwdriver.

Note:

The sensor is ready for use after a running-in period of 1 minute. During that period the zero-point signal is transmitted.

Please observe proper handling procedures for test gas bottles (regulations TRGS 220)!

5.1 Correction of the zero-point at the analog output signal

The analog output signal is factory set to the zero-point. If necessary, a manual adaptation of the analog signal is possible within 10 sec. after having applied the supply voltage.

- Jumper 0-20 % for signal start has to be set (= 4 mA or 2 V).
- Connect digital voltmeter (300 mV) at test pint “Test” (measuring signal ~ 40 mV = 4.0 mA).
- Switch on the operating voltage.
- Each pressing on the “Zero” push-button increases the signal by + 0.5 mV (0.05 mA). Press the button repeatedly until the measuring signal reaches 40 ± 0.2 mV. When reaching 44mV the signal starts again at 36 mV. The correction is only possible within the 10 seconds after having switched on the power supply. An impulse pause of more than 10 sec. cancels the release of the correction function.

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

5.2 Calibration

Manual calibration is possible both in analog mode and in DGC-05_Bus mode.

In the DGC-05_Bus mode the jumper V-A has to be set before manual calibration. Only by doing so the control voltage is available at the test pins X6. Remove the jumper after calibration

5.2.1 Zero-point

- Open cover of transmitter; fasten the calibration adapter with the elastic band at the cover. See fig. 5. The calibration adapter must hermetically seal the cover.
- Connect digital voltmeter at test pin “test”.
- Apply nitrogen (1500 ml/min; 1 Bar (14.5 psi) ± 10%) to the sensor.
- Wait 3 minutes until the signal is stable, push button “Zero” for 8 seconds.

  After successful calibration the measuring signal is corrected automatically. Depending on the selected signal starting point the measuring signal shows the following values:

  Signal start at 2 V or 4 mA 40 mV = 0 ppm
  Signal start at 0 V or 0 mA 0 mV = 0 ppm

  If the zero-point is out of the admissible range (> 20 mV at starting point 0% / > 60 mV at starting point (20%) before calibration, there is no correction of the measuring signal. The sensor has to be replaced.

5.2.2 Gain

- Open cover of transmitter; fasten the calibration adapter with the elastic band at the cover. See fig. 5. The calibration adapter must hermetically seal the cover.
- Connect digital voltmeter at test pin “test”.
- Apply calibration test gas N_2O (1500 ml/min; 1 Bar (14.5 psi) ± 10%).
- Wait 3 minutes until the signal is stable, adjust control voltage with potentiometer ”Gain” until the signal corresponds to the calculated value ± 3 mV, see calculation, section 5.2.3.
- Remove calibration adapter and close the cover.

  By limiting the gain factor, calibration will not be possible any more when the sensitivity of the sensor reaches a residual sensitivity of 30 %. Then the sensor has to be replaced.

5.2.3 Calculation of Control Voltage

Signal start 2 V / 4 mA

$$\text{Control voltage (mV)} = \frac{160\ (\text{mV}) \times \text{test gas concentration } N_2O\ (\text{ppm})}{\text{measuring range } N_2O\ (\text{ppm})} + 40\ (\text{mV}).$$

Signal start 0 V / 0 mA

$$\text{Control voltage (mV)} = \frac{200\ (\text{mV}) \times \text{test gas concentration } N_2O\ (\text{ppm})}{\text{measuring range } N_2O\ (\text{ppm})}$$

Example:

Measuring range	2000 ppm
Test gas concentration	500 ppm
Control voltage: Signal start 2 V / 4 mA	80 mV
Control voltage: Signal start 0 V / 0 mA	50 mV

Signal start: 2 V / 4 mA

$$\frac{160\ (\text{mV}) \times 500\ (\text{ppm})}{2000\ \text{ppm}} + 40\ (\text{mV}) = 80\ \text{mV}$$

Signal start: 0 V / 0 mA

$$\frac{200\ (\text{mV}) \times 500\ (\text{ppm})}{2000\ (\text{ppm})} = 50\ \text{mV}$$

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

5.3 Addressing, only for DGC-05_Bus mode

In the DGC-05_Bus mode each transmitter gets its communication address.

In the standard version with the communication connector X12, addressing is done by means of the DGC-05 Service Tool or by the DGC-05 Configuration and Calibration Software. See user manual of the Service Tool or of the Configuration and Calibration Software.

In the manual addressing version which can be identified by the address switch being equipped, there is a maximum of 60 addresses to be selected. See fig. 3.

The jumper is responsible to define the address group and the switch to define the address according to the following table.

Switch position	Jumper pos. 01 = address	Jumper pos. 02 = address	Jumper pos. 03 = address	Jumper pos. 04 = address
0	inactive	inactive	inactive	inactive
1	01	16	31	46
2	02	17	32	47
3	03	18	33	48
4	04	19	34	49
5	05	20	35	50
6	06	21	36	51
7	07	22	37	52
8	08	23	38	53
9	09	24	39	54
A	10	25	40	55
B	11	26	41	56
C	12	27	42	57
D	13	28	43	58
E	14	29	44	59
F	15	30	45	60

5.4 Option Relay Output

The two relays are activated in dependence of the gas concentration. If the gas concentration exceeds the adjusted alarm threshold, the corresponding relay switches on. If the gas concentration falls below the threshold minus hysteresis, the relay switches off again.

The contact function for relay 2, NC (normally closed) or NO (normally open), can be selected via the jumper NO/NC. See fig 1 and 3. Relay 1 is equipped with a change-over contact.

Via the ModBus interface the two alarm thresholds and the hysteresis are freely adjustable at the PC within the measuring range. The procedure can be read from the user manual “ModBus Software”.

The following parameters are factory-set.

Alarm threshold 1 = Relay 1: 500 ppm
Alarm threshold 2 = Relay 2: 1000 ppm
Switching hysteresis: 50 ppm

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

6 Inspection and Service

Inspection, service and calibration of the transmitters should be done by trained technicians and executed at regular intervals. We therefore recommend concluding a service contract with MSR or one of their authorized partners.

According to EN 45544-4, inspection and service has to be executed at regular intervals. The maximum intervals have to be determined by the person responsible for the gas warning system according to the legal requirements. MSR-E recommends checking the PolyGard Transmitter every three months and maintaining it every 48 months. If different intervals are indicated, always consider the shortest interval.

Inspections and services must be documented. The date for the next maintenance has to be affixed to the transmitter.

6.1 Inspection

The PolyGard Transmitter should be controlled regularly by a competent person according to EN 45544-4. The following has to be checked in particular:

- Maintenance/ calibration interval not exceeded.
- Visual inspection of the transmitter including cable for damage etc.
- Remove dust deposits, especially at the gas inlet.
- The filter at the gas inlet has to be replaced if extremely dirty.

6.2 Service and Calibration

When performing the maintenance you have to do the calibration and the functional test in addition to the inspection.

- Calibration: See section 5.
- Functional test: Check the output signal at the test pins during calibration.

6.3 Exchange of Sensor Element

The sensor is always replaced together with the cover.
Consider static electricity! See point 3.

- Unplug basic PCB SM03 carefully from the bottom part.
- Unplug the 4-pin plug from the IR sensor.
- Loosen the safety rope at the cover.
- Exchange the cover-sensor unit.
- Fasten the safety rope at the cover.
- Re-plug the 4-pin plug at the sensor. See fig. 3 for the position.
- Re-plug the PCB MS03 into the terminal blocks X4, X5 carefully.

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

7 Troubleshooting

7.1 Analog Mode

Trouble	Cause	Solution
Output signal < 3 mA / 1,5 V and/or control voltage < 30 mV only for starting signal 2V/4 mA	Jumper 0-20 % not set	Check jumper position
	Power voltage not applied	Measure tension at X4: Two-wire: Pin 1 (+) and 4 (-) Three-wire: Pin 1 (+) and 2 (-)
	PCB AT03 not plugged in correctly at X4 and X5	Replug PCB correctly
	Wire break	Check the wiring
Output signal > 22 mA /220 mV	Short-circuit	Check the wiring
No reaction of the output signal in spite of gas concentration	Power voltage not applied	Measure tension at X4
	Signal (Pin 4) not wired correctly	Check the wiring

7.2 DGC-05_Bus Mode

Trouble	Cause	Solution
Yellow LED not shining	Power voltage not applied	Measure tension at X4: Pin 1 (+) and 2 (-)
	PCB not plugged in correctly at X4/X5	Replug PCB correctly
	Wire break	Check wiring
Yellow LED not flashing	No communication at the transmitter	Transmitter not addressed, check bus wiring incl. topology and termination Voltage < 16 V
No control voltage for calibration	Jumper V-A not set	Set jumper. Remove it after calibration.

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

8 Technical Data

General sensor performances	
Gas type	Dinitrogen monoxide (laughing gas) N_2O
Sensor element	Two-beam infrared (NDIR)
Measuring range	0 - 2000 ppm (standard)
Temperature range	- 10 °C to + 40 °C (14°F to 104°F)
Pressure range	800 -1200 hPa
Humidity	0 – 95 % RH non condensing
Storage temperature range	0 °C to 50 °C (32 °F to 122 °F)
Storage time	Max. 6 months
Mounting height	0.6 to 0.8 m (2 to 2.5 ft.)
Stability & resolution	< 4 % of full scale
Repeatability	< 4 % of full scale
Resolution	10 ppm
Long-term zero-point drift	< 1% signal loss/year
Long-term output signal drift	< 2% signal loss/year
Expected lifetime	> 10 years/ normal operating conditions
Recommended calibration interval	> 4 years
Electrical	
Power supply	18 - 28 VDC/AC, reverse polarity protected
Power consumption (without options)	45 mA, max. (1.1 VA)
Output signal	
Analog output signal Selectable: Current / tension Starting point 0 / 20 %	(0) 4 – 20 mA, load ≤ 500 Ω, (0) 2 - 10 V; load ≥ 50 k Ω proportional, overload and short-circuit proof
Serial interface	
Transceiver	RS-485 / 19200 Baud (9600 ModBus)
Protocol, depending on version	MSR_DGC05 or ModBus
Physical	
Enclosure	Polycarbonate
Flammability	UI 94 V2
Enclosure colour	RAL 7032 (light gray)
Dimensions	(W x H x D) 94 x 130 x 57 mm
Weight	0.5 kg (1 lbs.)
Protection class	IP 65
Mounting	Wall mounting
Cable entry	Standard 1 x M 20
Wire connection	Screw-type terminal 0.25 to 2.5 mm^2 24 to 14 AWG
Wire distance	Current signal ca. 500 m (1500 ft.) Voltage signal ca. 200 m (600 ft.)
Guidelines	EMC Directive 2004 / 108 / EEC
	CE
Approvals	
Enclosure Type A	UL 508A
Warranty	1 year on material (without sensor)

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

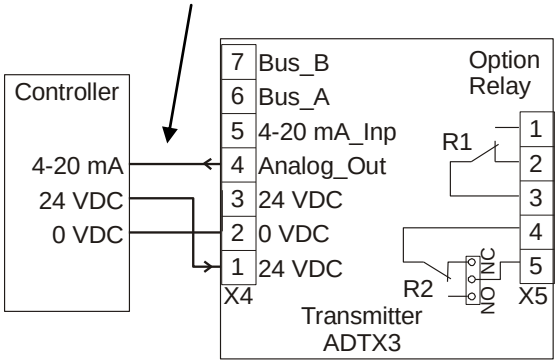
Options	
Relay output	
Alarm relay 1	30 VAC/DC 0,5 A, potential-free, SPDT
Alarm relay 2	30 VAC/DC 0,5 A, potential-free SPNO/SPNC
Power consumption	30 mA, (max. 0.8 VA)
Warning buzzer	
Acoustic pressure	85 dB (distance 300 mm) (1 ft.)
Frequency	3,5 kHz
Power consumption	30 mA, (max. 0.8 VA)
LCD display	
LCD	Two lines, 16 characters each, not illuminated
Power consumption	10 mA, (max. 0.3 VA)
LCD indication	
Green, yellow, red	Power supply, Low- Alarm, High- Alarm
Power consumption	10 mA, (max. 0.3 VA)
Heating	
Temperature controlled	3 °C ±2°C (37.5 °F ± 3.6 °F)
Ambient temperature	- 40 °C (- 40°F)
Power consumption	0.3 A; 7.5 VA
Analog input	
Only for RS-485 mode	4 – 20 mA overload and short-circuit proof, input resistance 200 Ω
Power supply for external transmitter	24 VDC max. 50 mA

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

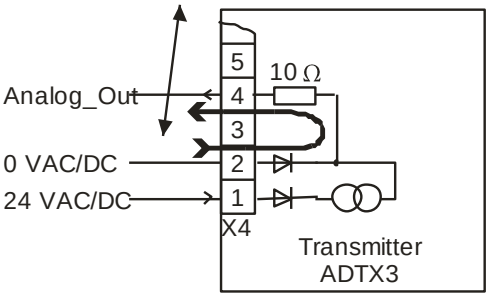
9 Figures

Application: Analog mode
Fig. 1

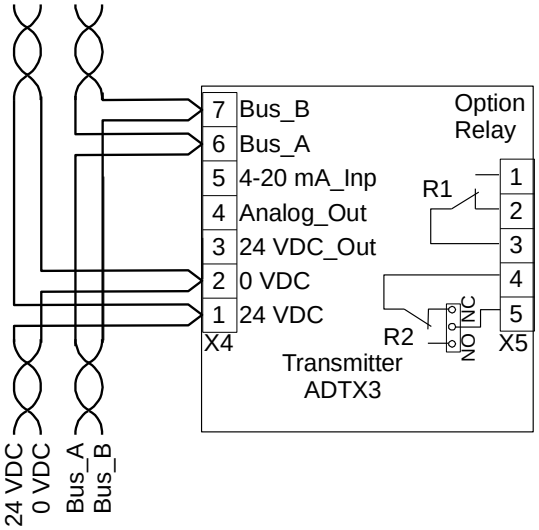
Do not connect power supply at this pin!
0VDC, 24 VAC, or 0 VAC will destroy the transmitter!



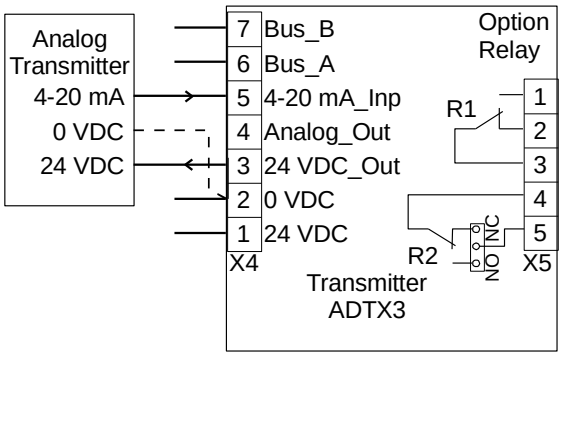
Short circuit at 24 VAC at pin 2 und pin 4
or +24 VDC at pin 2 and 0 VDC at pin 4!!
= R 10 burns up!!



Application: DGC-05_Bus mode or ModBus mode
Fig. 2



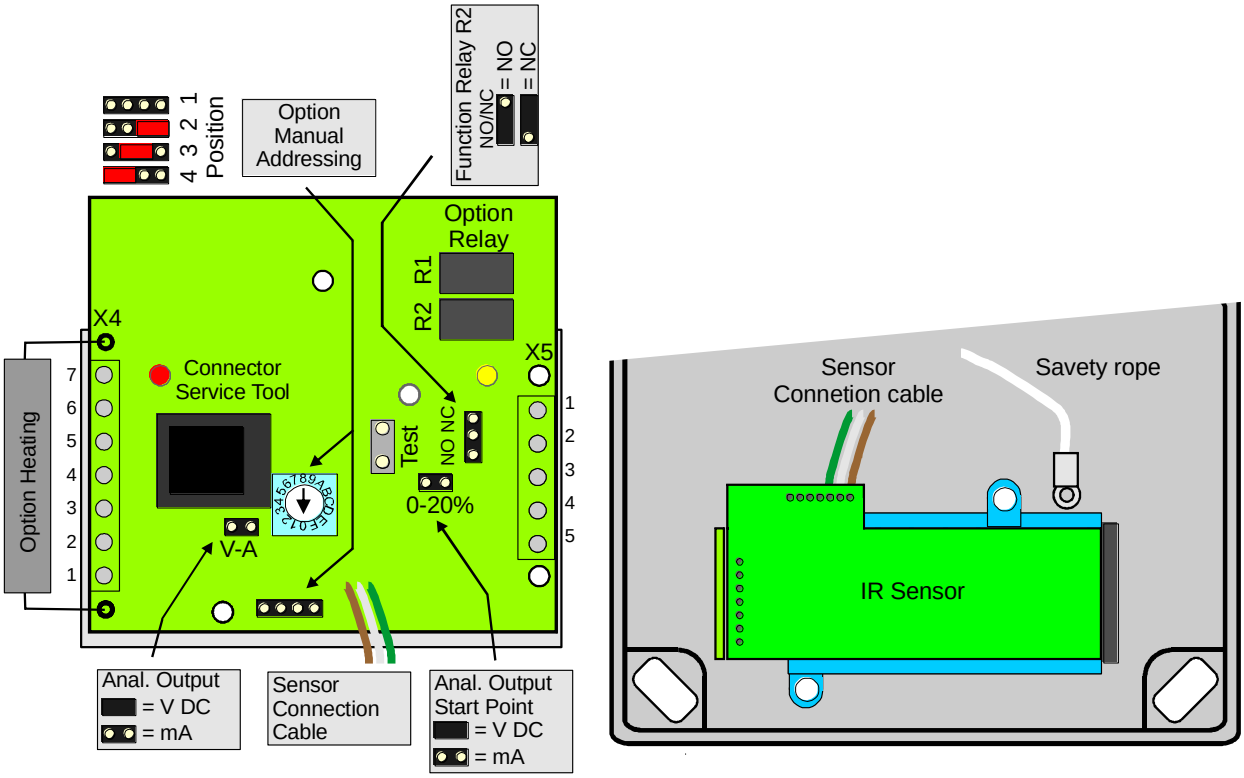
Connection field bus and tension



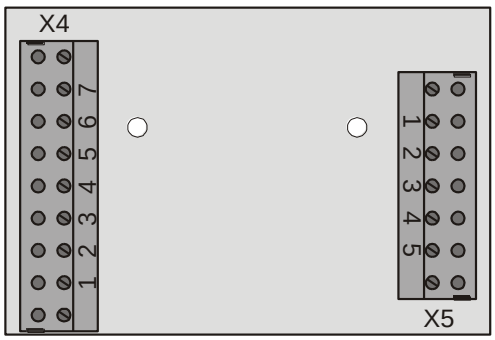
Connection analog transmitter
- Two- or three-wire connection, depending on transmitter type

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

PCB SM03
Fig. 3



Terminal block

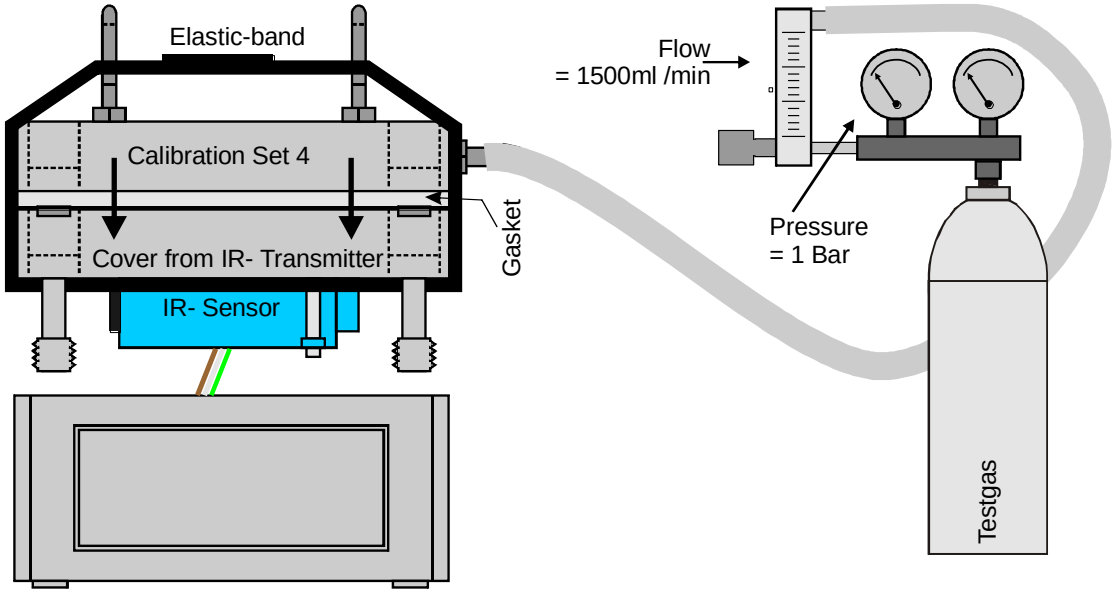


Selection analog output signal
Fig. 4

Jumper 0- 20 %	Jumper V-A	Output signal
Not set	Not set	0 – 20 mA
Set	Not set	4 – 20 mA
Not set	Set	0 – 10 V
Set	Set	2 – 10 V

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

Calibration adapter
Fig. 5



10 Part Disposal

Since August 2005 there are EC-wide directives defined in the EC Directive 2002/96/EC and in national codes concerning the waste electrical and electronic equipment and also regarding this device.

For private households there are special collecting and recycling possibilities. For this device isn't registered for the use in private households, it mustn't be disposed this way. You can send it back to your national sales organisation for disposal. If there are any questions concerning disposal please contact your national sales organisation.

Outside the EC, you have to consider the corresponding directives.

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de

11 Notes and General Information

It is important to read this user manual thoroughly and clearly in order to understand the information and instructions. The PolyGard® transmitters must be used within product specification capabilities. The appropriate operating and maintenance instructions and recommendations must be followed.

Due to on-going product development, MSR reserves the right to change specifications without notice. The information contained herein is based upon data considered to be accurate. However, no guarantee is expressed or implied regarding the accuracy of this data.

11.1 Intended Product Application

The PolyGard® transmitters are designed and manufactured for control applications and air quality compliance in commercial buildings and manufacturing plants.

11.2 Installers' Responsibilities

It is the installer's responsibility to ensure that all PolyGard® transmitters are installed in compliance with all national and local codes and OSHA requirements. Installation should be implemented only by technicians familiar with proper installation techniques and with codes, standards and proper safety procedures for control installations and the latest edition of the National Electrical Code (ANSI/NFPA70). It is also essential to follow strictly all instructions as provided in the user manual.

11.3 Maintenance

It is recommended to check the PolyGard® transmitter regularly. Due to regular maintenance any performance deviations may easily be corrected. Re-calibration and part replacement in the field may be implemented by a qualified technician and with the appropriate tools. Alternatively, the easily removable plug-in transmitter card with the sensor may be returned for service to MSR-Electronic-GmbH.

11.4 Limited Warranty

MSR-Electronic-GmbH warrants the PolyGard® transmitters for a period of one (1) year from the date of shipment against defects in material or workmanship. Should any evidence of defects in material or workmanship occur during the warranty period, MSR-Electronic-GmbH will repair or replace the product at their own discretion, without charge.

This warranty does not apply to units that have been altered, had attempted repair, or been subject to abuse, accidental or otherwise. The warranty also does not apply to units in which the sensor element has been overexposed or gas poisoned. The above warranty is in lieu of all other express warranties, obligations or liabilities.

This warranty applies only to the PolyGard® transmitter. MSR-Electronic-GmbH shall not be liable for any incidental or consequential damages arising out of or related to the use of the PolyGard® transmitters.

Phone 0049(0)8531/9004-0 Fax: 0049(0)8531/9004-54
MSR-Electronic GmbH, Würdinger Str. 27, D 94060 Pocking www:msr-electronic.de